APPARATUS AND METHOD FOR TREATING SYNTHETIC GRASS TURF

FIELD OF THE INVENTION

[0001] The present invention relates to an apparatus and method for treating synthetic grass turf particularly, but not exclusively, used as sports surfaces. Such synthetic grass turf is generally infilled with a layer of sand and/or other particulate material as part of its structural makeup.

BACKGROUND OF THE INVENTION

[0002] A synthetic grass turf generally comprises a synthetic backing sheet from which extend tufts of simulated grass fibers of a plastic material. The backing sheet is placed on a base substrate having drainage functions. Sand and/or other materials are layered over the backing sheet filling the spaces between the simulated grass fibers so that the simulated grass fibers remain substantially erect, and produce a flat surface which provides a ball-rebound similar to a natural grass court surface.

[0003] One typical example of the infill layers is described in the Applicant's United States Patent 5,958,527, issued on September 28, 1999. The exemplary infill layer includes a base course made of hard sand granules disposed immediately upon the top surface of the backing sheet, a middle course made of intermixed hard sand granules and resilient rubber granules, and a top course exclusively made of resilient rubber granules.

[0004] Infilled synthetic grass surfaces can firm up from the natural process of particulate compaction and settling.

In addition to this compacting and the effects of settling, the effect of vehicles, and or foot traffic on such surfaces also contributes to the compacting of the surfaces. In addition, the addition of dirt falling onto the surface over many years has an effect of filling the very small interstices between the particulate material that has been deposited between the fibers of the synthetic grass surface. The addition of dirt falling onto the surface and into the infill will also add to compaction of the infill.

[0005] In addition to the phenomena of dirt falling onto and into the infill, in many cases silt can also be deposited onto the surface and into the infill by means of floods or heavy rainfall causing a flow of water on the surface from adjacent silt and dirt laden grounds, and or from the normal flow of drainage water flowing over the surface from surrounding grassy and or dirt laden areas. This dirt and silt can eventually also lead to not only compaction but to creating a fertile ground for weeds and such to grow into. In most cases, having weeds grow into an artificial grass surface is unwanted and requires maintenance to remove and or prevent such growth.

[0006] The compacted layer can substantially reduce correct drainage of the surface and also reduces the proper resiliency and shock absorption properties required for sports, and therefore, may cause injury to the players. Accordingly, these synthetic grass turfs require treatment from time to time. Non-sport applications may require more frequent treatment to prevent growth of weeds in the infill depending on the geographical location.

[0007] Conventionally, high pressure water can be used with the use of plastic or wire brushes to treat the compacted and contaminated infill layer of the synthetic grass turfs. However, high pressure water washing is a messy process and usually necessitates replacement of much of the particulate, and a considerable amount of leveling work. Furthermore, soft plastic brushes are not very effective in removing infill to a significant depth, hard plastic brushes are too abrasive for the fibers, and wire brushes can damage the synthetic grass fibers.

[0008] Efforts have been made to improve synthetic grass turf cleaning and renovating. An apparatus and a method for renovating a synthetic grass turf is disclosed in United States Patent 5,562,779, issued to Allaway et al. on October 8, 1996 and in Canadian Patent Application 2,170,164, invented by Keal et al. and laid open to the public on March 9, 1995, respectively. The common feature of the apparatuses and methods disclosed by Allaway et al. and Keal et al. is to position nozzles slightly above the surface of the synthetic grass turf in order to direct pressurized air onto and at an inclined angle to dislodge fine and coarse particulate matter therefrom. The fine and coarse particulate matter is separated and then the coarse particulate matter is returned to the surface. However, the pressure of the air jets above the synthetic grass required to adequately penetrate the infill can damage these synthetic fibers. This air pressure can be varied in order to penetrate deeper into the pile to remove particulate material. However, this substantially agitates the infill and may mix the various layers of infill in ways that may not be favorable to the originally designed characteristics of the installation. Projecting air from the top of the synthetic grass does not afford proper

controls in order to achieve control of the infill. These apparatuses and methods therefore, have limited applications and have a reduced performance when used to renovate synthetic grass turfs having relatively thick infill layers, as disclosed in the Applicant's prior art patent. Increasing the air pressure may improve renovating performance but over-pressurized air jets will cause further damage to the synthetic grass fibers. Therefore, it is desirable to develop improved apparatuses and methods for treating synthetic grass turfs.

SUMMARY OF THE INVENTION

[0009] It is one object of the present invention to provide an apparatus for synthetic grass or natural surface turf treatment in various applications.

[0010] It is another object of the present invention to provide a method for treating synthetic grass turf, which can be performed for various applications.

[0011] In accordance with one aspect of the present invention, there is provided an apparatus for treating a synthetic grass turf which comprises a hollow cylinder including a plurality of hollow spikes extending radially and outwardly therefrom. Each of the spikes has an orifice therethrough in fluid communication with an inner space defined within the hollow cylinder. The hollow cylinder is rotatably supported on a support frame at a predetermined height with respect to the synthetic grass turf when the support frame is positioned on the synthetic grass turf. The apparatus further includes a pressurized fluid system for controllably supplying pressurized fluid into the hollow cylinder and thereby enabling fluid to be expelled from at least a number of the spikes to treat the synthetic

grass turf when the apparatus moves on the synthetic grass turf thereby causing the hollow cylinder to rotate.

[0012] The pressurized fluid system preferably comprises a pressurized air source, a pressurized air distributor operatively disposed within the hollow cylinder for selectively distributing pressurized air into a selected number of the hollow spikes, and a pressurized air line connecting the pressurized air distributor to the pressurized air source. The support frame preferably includes means for adjusting the height of the hollow cylinder so that the spikes are adapted to penetrate the top surface of the synthetic grass turf to a selected depth thereof.

[0013] In one embodiment of the present invention, the above-described hollow cylinder with the hollow spikes extending therefrom is rotatably supported on a support frame, and a number of the spikes penetrate the top surface of the synthetic grass turf to a selected depth thereof when the frame is positioned on the synthetic grass turf so that the pressurized air system enables air jets to be blown from at least a number of the spikes to dislodge the compacted particulate matter layered on the synthetic grass turf when the apparatus moves on the synthetic grass turf thereby causing the hollow cylinder to rotate. A vacuum system is provided in the apparatus for collecting particulate matter blown from the synthetic grass turf. The vacuum system further includes means for separating the particulate matter from the air flow carrying the particulate matter. For example, a cyclone device is provided for separating the coarse particulates from the air flow and a filtering device is provided for separating the fine particulates from the air flow. The frame is

preferably equipped with wheels so that the apparatus can be towed on the wheels, for example by a tractor.

[0014] In another embodiment, a pressurized air distributor is further provided for selectively distributing pressurized air into only a selected number of the hollow spikes. Thus, the required volume of the pressurized air is reduced and thereby for example, a small sized air compressor may be used for generating the pressurized air. The pressurized air distributor includes, for example an air channel disposed parallel to a rotating axis of the hollow cylinder, and is supported within the hollow cylinder in a manner such that the air channel maintains a predetermined stationary position while the hollow cylinder is rolling on the synthetic grass turf. The air channel is in fluid communication with the pressurized air source and includes an opening to expel pressurized air into a number of hollow spikes at a moment when those hollow spikes move to within an area of the opening during a synthetic grass turf treatment operation.

[0015] In accordance with another aspect of the present invention, there is provided a method for treating a synthetic grass turf. The method of the present invention comprises a step of directing pressurized fluid such as air or liquid into a depth of the synthetic grass turf for treatment, using a hollow spike roller rolling on the synthetic grass turf. The hollow spike roller enables fluid to be expelled from a number of hollow spikes that penetrate a top surface of the synthetic grass turf to the depth thereof without damaging the fibers.

[0016] This method can be used in various synthetic grass turf treatment applications. For example, pressurized air

can be directed to a selected depth of the synthetic grass turf to uplift particulate matter layered on the synthetic grass turf. The penetration depth of the spike nozzles can be adjusted so that different particulate component layers of the synthetic grass turf can be affected. In a treatment for renovating the entire particulate matter layered on the synthetic grass turf, the penetration depth of the hollow spikes should be adjusted to a depth corresponding to the thickness of the entire infill layer, for example the top, intermediate and base courses, as described in the Applicants United States Patent 5,958,527, and the different particulate materials can be collected by a vacuum system and then, if necessary, separated by separating and filtering devices. In a treatment for dislodging only a top course of the rubber granules of the particulate matter laid on the synthetic grass turf, the penetration depth of the hollow spikes should be adjusted to correspond to the depth of only the top course. In a treatment for functioning as an air brush to brush the tips of the synthetic grass blades and to level the top surface of the synthetic grass turf, the penetration depth of the hollow spikes should be significantly reduced so that the hollow spikes barely touch the top surface of the synthetic grass turf. This can also be applied to any infilled type of system. The hollow spikes preferably have holes on the side of the spikes in order to be able to better direct the flow of air in the direction most favorable to achieving the desired result. However, holes in the spikes can also be located on the tips of the spikes for use more as an air brush. If the spikes have holes in the tips then they could also be clogged quickly from the various sizes of particulate material and therefore become useless. This in

turn would cause unevenness in the end result of the treatment process.

[0017] In another example of the synthetic grass turf treatment applications, water can be directed to a relatively greater depth of the synthetic grass turf for flushing a drainage system beneath the synthetic grass turf with or without a surfactant type of fluid, for example a spacing grid preferably made of an extruded tri-plannar polypropylene geotextextile material, as is described in the Applicant's Canadian Patent Application 2,393,240 filed on July 12, 2002. It can also be directed to inject a surfactant deep into the fibers at the level of the backing material in order to help flush the fine particles of dust that accumulate over time through the backing.

[0018] In a further example of the synthetic grass turf treatment applications, the method of the invention can be used to inject liquid rubber material into a compacted sand base layer beneath the backing sheet of the synthetic grass turf for adding resiliency and impact absorption to a new and/or existing synthetic grass turf, as is described in the Applicant's Canadian Patent Application 2,409,637, filed on October 24, 2002.

[0019] Other advantages and features of the present invention will be better understood with reference to preferred embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Having thus generally described the nature of the present invention, reference will now be made to the accompanying drawings, showing by way of illustration the preferred embodiments thereof, in which:

[0021] Fig. 1 is a schematic diagram of one embodiment of the present invention illustrating a synthetic grass turf treatment apparatus including a fluid ejection system using a hollow spike roller assembly and a vacuum system;

[0022] Fig. 2 is a front elevational view of one embodiment of the hollow spike roller assembly used in the apparatus of Fig. 1;

[0023] Fig. 3 is a cross-sectional view of the hollow spike roller taken along line 3-3 of Fig. 2 having an air channel according to one embodiment thereof, shown in a working condition thereof in one synthetic grass turf treatment application;

[0024] Fig. 4 is a cross-sectional view of an air channel according to another embodiment of the hollow spike roller assembly of Fig. 2;

[0025] Fig. 5 is a longitudinal cross-sectional view of the air channel of Fig. 4;

[0026] Fig. 6 is a cross-sectional view of the hollow spike roller assembly incorporating the air channel of Figs. 4-5, being adjusted at a higher level in contrast to the spike roller position illustrated in Fig. 3; and

[0027] Fig. 7 is a cross-sectional view of the hollow spike roller assembly showing the air channel adjusted at an angle and the roller assembly adjusted at a height, both different from those illustrated in Fig. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Fig. 1 is a diagram schematically illustrating a grass turf treatment apparatus which is particularly useful

for treating synthetic grass turfs. However, the apparatus can also be used to treat natural grass turfs. According to one preferred embodiment of the present invention, the apparatus which is generally indicated by numeral 10, includes a fluid ejection system 12 and a vacuum system 14.

[0029] The fluid ejection system 12 generally includes a pressurized fluid source 16. In various applications, the pressurized fluid source 16 varies when different types of fluid are required. This embodiment illustrates the use of pressurized air, which is more commonly but not exclusively used in a synthetic grass turf treatment operation, and so the fluid source 16 is preferably an air compressor. The fluid ejection system 12 employs a hollow spike roller assembly 18 to direct the pressurized air in a desired direction to a depth of a synthetic grass turf to be treated. This means the spiked roller will have strategically placed spikes that will intermittently release a jet of compressed air as the spike penetrates the fiber depth and reaches a specific angle. This jet of air will be released for a very short time and then the air to that spike will be shut off until it reaches the same angle again while the spike roller assembly 18 is rotating, as indicated by arrow R. This operation is repeated with all of the hollow spikes over the width of the unit. However, this does not prevent the system from operating with all of the spikes expelling air at the same time. Intermittent expulsion of the air reduces the size of the compressor required to supply that air. The detailed structure of the hollow spike roller assembly 18 will be described with reference to Figs. 2 and 3 hereinafter.

[0030] An air pressure and volume controlling device 20 is also provided so that the pressure of the pressurized air

supplied to the hollow spike roller assembly 18 through a pressure air line 22 is adjusted to meet different pressure requirements for the jets of air to be blown from the hollow spike roller assembly 18 in various synthetic grass turf treatment applications.

[0031] The vacuum system 14 in this embodiment includes a vacuum head 24, a particulate separation device 26, a filtering device 28 and a vacuum fan 30 which are all connected by air duct 32. The vacuum head 24 for example, generally includes a chamber with an open bottom, which is positioned downstream of and close to the hollow spike roller assembly 18, at a level slightly above the top surface of the synthetic grass turf to be treated. Thus, the air jets, as indicated by arrow J, blown from the hollow spike roller assembly 18 along with particulate matter which is uplifted and carried by the air jets J, as well as fresh air indicated by arrow F, are sucked into the vacuum head 24. The air jets J can be adjusted by air pressure and volume device 20 to project the required distance to be vacuumed up by the vacuum head 24. A powered rotary brush 34 is optionally attached within the vacuum head 24 to facilitate the collection of particulate matter. The particulate matter collected in the vacuum head 24 is then carried by the air flow through the air duct 32, to enter the particulate separation device 26, if necessary. As the apparatus moves in a direction of D, the operation is performed along a strip area of a synthetic grass turf.

[0032] The particulate separation device 26 generally includes a closed container 36 preferably having a conical bottom 38. A cyclone device 40 or other device is provided within the closed container 36 to reduce the velocity of

the heavier particulate, such as sand. Thus, the heavier particulates are separated from the air flow and fall down to the sloped or conical bottom 38 of the container 36. An endless screw conveyor 42 is preferably provided at the sloped or conical bottom 38 to deliver the sand or other particulates to appropriate collection containers for re-use or to directly return the sand or other particulates to a predetermined area of the synthetic grass turf which has been air-blown by the hollow spike roller assembly 18.

[0033] After the carried sand or other particulates have been separated and collected in the container 36, the air flow which now carries the remaining relatively light and fine particulates, such as dust, flows through the air duct 32 to enter the filtering device 28. The filtering device 28 generally includes a container 44 equipped with a removable or slidable dust collection pan 46 which is positioned at the bottom of the container 44. Filtration elements such as a group of dry polyester cartridges 48 are installed within the container 44 so that the air flow entering the container 44 must past through the dry polyester cartridges 48 before exiting the container 44. The dust carried by the air flow in the container 44 is thereby separated from the air flow and is collected in the dust collection pan 46 which is periodically removed from the container 44, for cleaning. The dry polyester cartridges 48 are supported on a rack (not shown), in the container 44, and the rack with the dry polyester cartridges 48 can also be removed from the container 44, for example by a forklift, for cleaning. The clean air flow which exits from the filtering device 28 is then sucked through the air duct 32 into the vacuum fan 30, and is then discharged.

[0034] The vacuum system 14 can be varied to meet requirements for separating particular particulate components carried by the air flow in various applications. The infill layer of a synthetic grass turf typically comprising more than one type of particulate matter, such as sand and rubber granules, makes further separation stages necessary, which is well known in the industry and will not therefore be discussed in detail. All rubber infilled systems could be easier to treat since they are mainly comprised of only one material.

[0035] Referring to Figs. 2 and 3, the hollow spike roller assembly 18 includes a hollow cylinder 50 having a cylindrical side wall 52 and opposed end walls 54 to define an inner space therein. A plurality of preferably pointed hollow spikes 56 that have an equal length extend radially and outwardly from the cylindrical side wall 52. Each hollow spike 56 has an end with an orifice 58 therein in fluid communication with the inner space of the cylinder 50 through a fluid passage defined by the hollow spike 56. In this embodiment, the orifices 58 of all of the hollow spikes 56 face a common circumferential direction so that air jets blown from the orifices 58 are substantially perpendicular to the respective hollow spike 56, as is more clearly shown in Fig. 3. Nevertheless, the orifices 58 in the respective hollow spikes 56 can be drilled or shaped to be at various angles relative to the hollow spike, thereby projecting air and or fluid at various angles of more or less than a 90 degree position. These orifices 58 can be positioned to face in another direction or individually positioned to face in different directions relative to each other, in order to achieve various performance results in a variety of synthetic grass turf treatment applications, which will be discussed hereinafter. Alternatively, each

hollow spike 56 may have more than one orifice 58 if it is desired for particular applications. The orifice 58 in each hollow spike 56 can be located for example, in a position 3/8" from the pointed tip thereof and at a proximity to the pointed tip. The hollow spikes 56 in this embodiment form a plurality of longitudinal rows that offset axially with respect to those of adjacent rows, as is more clearly shown in Fig. 2. However, the distribution pattern of the hollow spikes 56 on the cylinder 50 can vary to meet the needs of various treatment applications, as long as the air jet distribution area of the hollow spikes 56 substantially covers the longitudinal length of the cylinder 50. There could be a relationship between the spacing of the hollow spikes in an offset manner and the spacing of the rows of fibers, in order to better disperse the air or fluid in a more uniform manner within the infill and or within the fibers. This can be beneficial for a far better coverage of the air and or fluid in one application instead of several. Narrower spacing but more intermittent spikes may be better for narrower spaced grass fiber rows.

[0036] The cylinder 50 is rotatably supported on a hollow shaft 60 that is affixed at the opposed ends thereof to a pair of brackets 62. The brackets 62 are connected to a main support frame 64 by adjusting means 66 in order to permit adjustment of the height of the cylinder 50 with respect to the surface of the synthetic grass turf, when the main support frame 64 is positioned on the synthetic grass turf. The main support frame 64 at the opposed sides thereof is equipped with a pair of wheels 68 so that the main support frame 64 can be towed on the wheels 68 by, for example a tractor, thereby causing the cylinder 50 to rotate and roll on the synthetic grass turf. The height of the cylinder 50 may be adjusted within a range between a

first position in which the hollow spikes 56 can penetrate to the greatest depth equal to the length of the hollow spikes 56, as shown in Fig. 3, and a second position in which the hollow spikes 56 barely touch the top surface of the synthetic grass turf (not shown). Alternatively, the hollow spikes 56 may be bent in an appropriate shape to facilitate the penetration.

[0037] The adjusting means 66 can be of a telescoping configuration with, for example locking pins, screw lift devices with locking nuts, hydraulic cylinders, or any other position adjusting mechanisms, which are well known in the art and will not therefore be further discussed.

[0038] An air channel 70 is provided within the hollow cylinder 50, functioning as a pressurized air distributor. The air channel 70 includes a top wall 72, opposed side walls 74 and opposed end walls 76, defining an elongate chamber with an open bottom 78 thereof. The air channel 70 extends parallel to the hollow shaft 60, in a length corresponding to the axial dimension of the inner space of the hollow cylinder 50, and is secured to the hollow shaft 60 by means of a plurality of brackets 80. Thus, the air channel 70 maintains a predetermined stationary position within the cylinder 50 while the cylinder 50 is rotating, if the air flow is to be directed at that corresponding angle. If the air flow needs to be at other angles, the air channel 70 can be rotated to another fixed position, as shown in Fig. 7. The pressurized air line 22 is connected to the air channel 70 through the hollow shaft 60 in order to supply pressurized air into the air channel 70. Thus, the pressurized air is blown from a number of hollow spikes 56 at a moment when those hollow spikes 56 rotate to a position within an area of the open bottom 78

of the air channel 70, as is predetermined according to the operation requirements of a particular application. For example, in the embodiment shown in Fig. 3, a maximum of three rows of hollow spikes 56 can blow air jets simultaneously because the open bottom is wide enough to be accessible to three rows of the hollow spikes 56 at one time. If only one row of hollow spikes 56 is needed to blow air jets at one time, the open bottom 78 of the air channel 70 will be much narrower or a narrow slot opening is provided in a closed bottom of the air channel 70 in order to be accessible to only one row of hollow spikes 56 at a time. Furthermore, accurate design of the width of the open bottom 78 also provides means for controlling the air jet blowing duration of each row of the hollow spikes 56 when the cylinder 50 rotates at a predetermined speed. In order to effectively distribute the pressurized air into the selected number of hollow spikes 56, the open bottom 78 is preferably contoured to closely correspond with the contour of the inner surface of the cylinder 50. Sealing means such as brushes or rubber strips attached to the periphery of the open bottom 78 are optional.

[0039] The air channel 70 is preferably angularly adjustable about the hollow shaft 60. Thus, the air channel 70 can maintain a stationary position at a required angle with respect to a vertical plane so that the air jets blowing from each row of the hollow spikes 56 can be controlled to blow at a required angle with respect to the synthetic grass turf.

[0040] The main support frame 64 can be optionally configured to support the entire apparatus 10, as shown in Fig. 1, including the fluid ejection system 12 and the vacuum system 14, or can be configured to support only the

fluid ejection system 12 when the apparatus is designed for particular applications which do not need a vacuum and separation operation. In either case, the pressurized air compressor 16 or other type of air source can either be supported on the main frame 64, or can be supported on the ground at a site near to the synthetic grass turf, and connected by a flexible pressure pipe (not shown) to the portable hollow spike roller assembly 18. The latter configuration may be more practical when the air channel 70 is omitted to simplify the structure of the apparatus so that a large capacity pressurized air compressor may be needed because air jets will be blown from all the hollow spikes 56 all the time.

[0041] Figs 4 and 5 illustrate an air channel according to another embodiment of the hollow spike roller assembly 18 of Fig. 2. The air channel generally includes a hollow cylinder axle 82 having closed opposed ends 84. The cylinder axle 82 has an external diameter slightly smaller than the inner diameter of the hollow cylinder 50. In this embodiment the hollow cylinder 50 does not include opposed end walls and the hollow cylinder axle 82 extends longitudinally through the entire hollow cylinder, such that the hollow cylinder 50 is rotatably supported on the hollow cylinder axle 82 when the hollow cylinder axle 82 is supported on the brackets 62 of Fig. 2, in a stationary position. Means, for example radial extending elements, may be provided on the hollow cylinder axle 82 for restraining axial movement of the hollow cylinder. A plurality of spaced-apart slot openings 86 extend in a circumferential direction in the hollow cylinder axle 82. The spacing thereof corresponds to the axial spacing of the hollow spikes 56 of Fig. 2 such that each of the hollow spikes 56 can obtain a pressurized air supply when aligning

with a corresponding one of the slot openings 86. The length of the slot openings 86 is predetermined for example, to cover at most, 3 hollow spikes 56 at one time, according to this embodiment as shown in Figs. 6-7. The hollow cylinder axle 82 includes one opening 88 at one end to be connected with the air pressure air line 22. The hollow cylinder axle 82 is adjustably fixed on the brackets 62 of Fig. 2 such that the hollow cylinder axle 82 can be angularly adjusted to permit the slot openings 82 towards a selected angle.

[0042] Figs. 6 and 7 illustrate the hollow cylinder axle 82 to be positional within the hollow cylinder 50 at different angles. Thus, the angular ranges in which the hollow spikes 56 blow the air jets are different in order to meet various application requirements. Figs. 6 and 7 also illustrate the height difference of the hollow cylinder 50 in order to meet various application requirements.

[0043] The apparatus 10 of the present invention can be used generally for implementing a grass turf treatment operation in which pressurized liquid is directed into a predetermined depth of the grass turf, as can be employed in various applications with regard to either treatments of synthetic grass turf that includes infill layers or does not include infill layers, or treatments of natural grass turf. A number of application examples are described below.

[0044] In a treatment for softening of the compacted infill layer of a synthetic grass turf, the cylinder 50 is adjusted to a height such that the hollow spikes 56 can penetrate to a depth of about the entire thickness of the

infill layer. If the infill layer includes only sand particulates, the vacuum system can be optional. However, when the infill layer includes multiple courses of different types of particulate materials, inclusion of the vacuum system with separation and/or filtering devices may be necessary, in order to collect the mixed particulate materials blown by air jets from the hollow spike roller assembly 18, and then separate them before appropriately layering the respective infill particulate materials back onto synthetic grass turf. In order to reduce the number of hollow spikes 56, adjacent rows of hollow spikes 56 and adjacent hollow spikes 56 within each row may be more widely spaced apart. In this case the pressurized air may be adjusted to a relatively high pressure for projecting the individual air jets over a longer distance. Optionally, a number of hollow spikes 56 within each row may be selected to have their orifices 58 positioned to face for example, in opposed side directions in order to ensure that the softening operation covers the entire longitudinal length of the cylinder 50. In a softening operation of a compacted infill layer of a synthetic grass turf, the cylinder 50 may be adjusted to a position relatively higher above the synthetic grass turf so that the hollow spikes 56 penetrate the synthetic grass turf only to a depth close to the thickness of the top course of the infill layer, when it is determined that the treatment should only uplift the top course of the infill layer, such as the rubber granules, in order to remove dust and other contaminants. This can also be performed by changing the angle of cylinder axle 82, as shown in Fig. 7.

[0045] In applications requiring only brushing the tips of the synthetic grass fibers of the synthetic grass turf, the cylinder 50 can be adjusted to its highest position such

that the hollow spikes 56 just barely touch the tips of the synthetic grass fibers. In this application, the air channel 70 is particularly designed and is positioned at an angle such that the air jets are blown from the hollow spikes 56 only in a substantially horizontal direction to form a moving air current on the top of the synthetic grass turf, thereby functioning as an air brush.

[0046] The hollow spike roller assembly 18 can be used alone without the vacuum system to inject either a liquid or small granule material into the infill layer of a synthetic grass turf in order to modify the performance of the infill layer and therefore the field surface. For example, water can be injected into the infill layer to enhance drainage of the infill layer. When the water is to be used substantially for flushing a drainage system such as a spacing grid positioned beneath the backing sheet of the synthetic grass turf or close to the backing on the top side of the backing, the cylinder 50 may be adjusted to allow the hollow spikes 56 to penetrate deeper and close to the backing sheet of the synthetic grass turf. The spikes can also be positioned to perforate the backing of the grass in order to enhance drainage and to enhance a flushing operation that may be occasionally required.

[0047] The hollow spike roller assembly 18 may also be used to inject a growth inhibitor into either a synthetic grass turf or a natural grass turf in order to prevent weeds from growing.

[0048] The apparatus may also be used to inject soil stabilizers into a natural grass turf for grass maintenance. Growth enhancers, seeds, and fertilizers may also be injected by the apparatus of the present invention,

into a synthetic grass turf when growing vegetables and other plants in the synthetic grass turf is desirable. By modifying the size of the hollow spikes, various sizes of seeds and or any particulate material can be injected into the desired substrate.

[0049] The apparatus of the present invention may also be used to inject small rubber granules and/or liquid rubber into the infill layer or the base layer beneath the backing sheet of the synthetic grass turf, for adding resiliency and impact absorption to the synthetic grass turf.

[0050] The application of the apparatus of the present invention cannot be exhaustively described and the above-described applications are examples only. Modifications and improvements to the above-described embodiments of the present invention may become apparent to those skilled in the art. The foregoing description is intended to be exemplary rather than limiting. The scope of the invention is therefore intended to be limited solely by the scope of the appended claims.